

Appl. No. 10/627,849
Amdt. dated 04/20/05
Reply to Office Action of 12/21/2004

Attorney Docket No.: N1085-00151
TSMC2003-0025

Amendments to the Drawings:

The attached two (2) sheets of drawings include corrected drawings in which each of Figures 1 and 2 has been amended to include the legend --Prior Art--.

5 Attachment: Two Replacement Drawing Sheets

REMARKS/ARGUMENTS

Claims 1-42 are pending in this application. Claims 1-13 have been rejected and it was indicated in the Office Action Summary sheet that claims 14-42 have been withdrawn from consideration. Applicants respectfully request re-examination,
5 reconsideration and allowance of each of pending claims 1-13 and 23-42.

Applicants would like to take this opportunity to thank Examiner Le for discussing the Office Action and Applicants' previously-submitted Response to Restriction Requirement in a telephone conversation with Applicant's undersigned representative, Mark J. Marcelli, that took place on March 4, 2005.

10 I. **Withdrawal of Claims 23-42**

The Examiner previously issued a Restriction Requirement on October 7, 2004 requiring Applicants to elect one of Group I, "claims 1-13 and 23-42," or Group II, claims 14-22. In Applicants' Response thereto, filed October 21, 2004, Applicants elected Group I for further prosecution, but due to a typographical error/omission, indicated that
15 they elected "Group I, claims 1-13," instead of stating "Group I, claims 1-13 and 23-42." Pursuant to the aforementioned telephone conversation with Examiner Le, Applicants respectfully request re-examination of claims 23-42 of Group I. Applicants point out that claims 23-27, 31 and 37 are being amended.

II. **Objection to the Drawings**

20 The drawings were objected to as it was indicated that Figures 1 and 2 should be designated by a legend such as --Prior Art--. Accordingly, Figures 1 and 2 have been amended to include the legend --Prior Art-- as appears in the Replacement Drawing Sheets attached hereto. The objection to the Drawings should therefore be withdrawn.

III. Objection to the Specification

The Specification was objected to as the Examiner states "The title of the invention is not descriptive." Applicants have amended the Specification for consistency with the claims election.

- 5 The Examiner also required a new abstract that is clearly indicative of the invention to which the claims are directed. A new abstract, indicative of the claimed invention is accordingly provided herein.

In view of the above, the objection to the Specification should be withdrawn.

IV. Rejection of Claims 1, 4, and 6-11

- 10 In the Office Action, specifically on page 3, last paragraph, claims 1, 4, 6-11 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Kammler, et al (USPN 6746927 B2), hereinafter "Kammler," in view of Lur, et al (USPN 6013569), hereinafter "Lur." Applicants respectfully submit that these claim rejections are overcome for reasons set forth below.

- 15 Applicants first point out that the claimed invention recites a combination of features, some of which may separately be known. It is the combination of these features which is claimed and non-obvious under the conditions of 35 U.S.C. §103.

Contact Etch Stopping (CES) Layer with Predetermined Stress

Amended independent claim 1 recites the feature of:

- 20 "a contact etch stopping (CES) layer formed over the recessed spacer and having the predetermined stress level being one of compressive and tensile."

- 25 On page 5, fourth paragraph of the Office Action, the Examiner states "Regarding claims 9-11, Lur et al. discloses a contact etching stopper (CES) layer28 formed over the recessed spacer with a predetermined stress level; the CES layer imposes a compressive stress and the CES layer imposes a tensile stress (Col 10, lines 10-17)."

Applicants respectfully traverse and submit that Lur does not disclose a CES or other conventionally known "etch stop layer". Moreover, Lur does not disclose a layer formed over the gate structure having a predetermined stress. Therefore Lur cannot and does not teach or suggest the claimed CES layer having a predetermined stress. Kammler
5 also does not teach or suggest a stressed etch stop layer and the Examiner does not allege that it does.

Returning to Lur, Applicants first point out that feature 28 is a silicide illustrated in the prior art drawing and not covered in column 10, lines 10-17. Lines 10-17 of column 10 recite "the deposition of an interpolysilicon or pre-metal dielectric layer such as
10 atmospheric pressure CVD SiO₂ or borophosphosilicate glass (BPSG) over the FIG. 9 structure. Vias are formed through the CVD SiO₂ or BPSG down to the ..." The interpolysilicon or pre-metal dielectric layer such as SiO₂ or BPSG is not an etch stop layer, i.e., not the claimed contact etching stopper layer. Since vias are formed through this subsequently deposited layer it is clear that this layer is the interpoly or pre-metal
15 dielectric layer and not an etch stop layer which is commonly known to be a material featuring drastically different etching characteristics than the material to be etched. The claimed CES layer prevents damage to underlying silicides when the interpoly or pre-metal dielectric is etched. Lur does not provide this advantage. There is no teaching or suggestion of an etch stop layer beneath the interpoly silicon or pre-metal dielectric
20 layer, or anywhere else, in Lur.

Moreover, Lur does not disclose any layer formed over the gate structure having a predetermined tensile or compressive stress. The claimed feature of a predetermined stress level being one of compressive and tensile is clearly distinguished from a film deposited without regard to its stress, such as the interpolysilicon or pre-metal dielectric
25 layer of Lur. *It is because of the enhanced and predetermined stress, in conjunction with the non-obvious spacer/liner configuration discussed below, that the structure of the present invention advantageously enjoys enhanced electron/hole mobility in the gate channel underneath the gate region.*

Amended independent claim 1 is therefore distinguished from the references of Kammler and Lur, taken alone or in combination. Claim 9 has been cancelled as its features added into independent claim 1. Therefore the rejection of claim 1 and dependent claims 4, 6-8, 10 and 11 under 35 U.S.C. § 103(a) under Kammler and Lur, should be withdrawn based on this feature.

Distinguished Relative Dimensions of the Spacer and Spacer Liner

Amended independent claim 1 further recites the features of:

“wherein a height of the recessed spacer is lower than a height of the sidewall liner,

wherein the horizontal part of the sidewall liner is shorter than the corresponding recessed spacer on top thereof”.

As known in the prior art, (for example, see Kammler) conventional processing *generally* forms spacers in/over the L-shaped liner such that both at the top and side of the structure, the spacer and liner have coincident edges. Since the liner and the spacer are formed of different material, the above-highlighted combination of features of claim 1 would not be attainable by performing a conventional selective isotropic etching procedure upon such a conventional structure. Either the liner would etch faster than the spacer producing a spacer having a greater height and width than the liner, or the spacer would etch faster than the liner producing a spacer having a lesser height and width than the liner. As such, the claimed combination of features of the spacer having a lower height than the liner but a greater width than the liner, would be virtually mutually exclusive using conventional technology as well as non-obvious.

The Examiner states, on page 4, first 3 paragraphs that Kammler teaches a semiconductor device “wherein a height of the first and second recessed spacers 9p is lower than a height of the sidewall liner 7p” and refers to FIG. 1f of Kammler. The Examiner then states “it would have been obvious to a person of ordinary skill in the art at the time the invention was made to form the horizontal part of each sidewall liner is shorter than the corresponding recessed spacer on top thereof in Kammler’s structure”,

page 4, lines 15-17 of subject Office Action. Applicants respectfully disagree that one of ordinary skill in the art at the time and in possession of the Kammler reference, would use the features of the structure illustrated in FIG. 1f of Kammler and combine it with another feature because Kammler provides FIG. 1f and points to this feature to illustrate
5 the shortcomings of the prior art. Kammler is directed to forming silicides on exposed sidewalls of gate structures that necessarily include sidewall spacers and the presence of sidewall liners at a height greater than that of the sidewall spacer, reduces the area of the gate structure upon which a silicide can be formed. Kammler recites "Accordingly, the benefit of overetching the spacers 9p is limited by the remaining dielectric material
10 on the gate upper sidewalls consisting of ... the liners 7p, since silicidation by horizontal metal diffusion through the upper sidewalls is hindered by the residual dielectric material" [of liners 7p]. Kammler, col. 4, l. 19-24. Kammler clearly teaches away from sidewall liner having a greater height than the sidewall spacer and one of ordinary skill would not want to retain that feature since it only appears in Kammler to demonstrate
15 deficiencies of conventional processing.

The cited reference of Lur, in contrast, teaches a gate electrode with liners and spacers and provides a gap between the sidewall spacers and proximate silicon surfaces that are to be silicided by virtue of the sidewall spacers having a greater height than the liners and a greater width than the bottom portion of the L-shaped liners that
20 are disposed between the sidewalls of gate electrode and the silicon substrate, and the spacer. This gap provides the silicide region forming on the exposed silicon surfaces of the gate electrode and silicon substrate room to expand without being subjected to lateral stresses during the silicidation process. One in possession of the Lur reference would therefore not use the structure shown in FIG. 1f of Kammler because it does not
25 provide the gap deemed to be so critical by Lur. As such Lur also teaches away from the use of, or combination with, the feature that appears in FIG. 1f of Kammler.

Moreover, applicants respectfully submit that there would be no motivation to pick and choose opposite features designed to produce opposite effects. The Examiner bears the initial burden of establishing a prima facie case of obviousness and Applicants

do not believe that the Examiner has upheld his responsibility of establishing a prima facie case of obviousness. There is no suggestion at all in either reference to combine its features with those of the other reference, much less to combine the features of one reference with a feature that another reference uses to illustrate the deficiencies of the prior art. The Examiner has combined features using hindsight reconstruction and without any evidence supporting the combination. The Examiner presented no evidence that one would combine the features in the proposed manner. Applicants submit that it is rather intuitive that each reference teaches away from combining the features for reasons discussed above, i.e., they produce opposite effects. There is no suggestion in the references to provide the claimed combination of a spacer height lower than the height of the sidewall liner but the horizontal part of the sidewall liner being shorter than that of the spacer on top thereof, and there is no suggestion as to why one would want to combine the features as such. Applicants have discovered that the advantage of such a shaped liner/spacer configuration is in the enhanced electron mobility in the channel produced by a stressed CES layer formed over the non-obvious gate structure.

Referring to the structure of FIG. 1F of Kammler, it might not be possible and certainly would not be obvious to etch the structure using an isotropic etch process to produce the structure recited in independent claim 1. In particular, it might not be possible to terminate the etch process at the precise point at which the liner 7p has laterally receded below spacer 9p but still extends slightly above the top of spacer 9p, and certainly wouldn't be obvious to do so for reasons set forth above. Kammler and Lur references would not provide any motivation to do so because Lur teaches spacers with greater dimensions than the respective liners and Kammler teaches a method for maintaining spacers and liners of the same dimension.

Moreover, the FIG. 1f structure of Kammler includes a further liner – further spacer 4p disposed between liners 7p and the gate electrode 3p. Therefore, even if someone were to take the undesirable prior art structure of Kammler, etch it to the precise point at which the height of sidewall liner 7p was greater than that of spacer 9p

while sidewall liner 7p receded laterally under spacer 9p, the structure would still lack the claimed feature of "portions of the respective sidewalls not covered by the sidewall liners being exposed" because of the presence of further spacer 4p along the sidewalls.

Independent claim 1 and therefore dependent claims 4 and 6-8, 10, 11 are
5 therefore further distinguished from the references of Kammler and Lur, taken alone or in combination.

Therefore the rejection of claim 1 and dependent claims 4, 6-8, 10 and 11 under
35 U.S.C. § 103(a) under Kammler and Lur, should be withdrawn.

V. Rejection of Claims 2, 3, 5 and 12-13

10 On page 5, fifth paragraph of the Office Action, claims 2, 3, 5 and 12-13 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Kammler in view of Lur and further in view of the Examiner's comment. Applicants respectfully submit that these claim rejections are overcome for reasons set forth below.

15 Claims 2, 3, 5 and 12-13 depend from amended independent claim 1 and are therefore distinguished from the references of Kammler and Lur, taken alone or in combination, as above. The Examiner remarks that the features of claims 2, 3, 5 and 12-13, directed to various numerical values associated with features of the Applicant's invention, would be obvious, "since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art", subject Office Action
20 page 6 line 1-3 and also lines 11-12.

The Examiner's comments do not make up for the above-stated deficiencies of the references of record and therefore the rejection of claims 2, 3, 5 and 12-13 under 35 U.S.C. § 103(a) as being unpatentable over Kammler in view of Lur and further in view of the Examiner's comment, should be withdrawn.

VI. Re-Examination of Claims 23-42

Applicants point out that claims 23-27, 31 and 37 have been amended and Applicants believe that each of claims 23-42 is distinguished from the references and in condition for allowance.

CONCLUSION

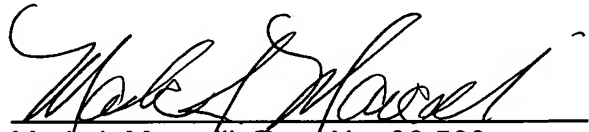
Based on the foregoing, Applicants respectfully submit that each of claims 1-13 and 23-42 is in allowable form and the application is therefore in condition for allowance, which action is respectfully and expeditiously requested by Applicants.

5

Respectfully submitted,

10 Dated:

20 April 2005


Mark J. Marcelli, Reg. No. 36,593
Attorney for Applicants

15 Attachment: Two Pages of Replacement Drawings

20 DUANE MORRIS LLP
101 West Broadway, Suite 900
San Diego, CA 92101
Telephone: (619) 744-2200
Facsimile: (619) 744-2201